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115TH CONGRESS
1ST SESSION

S. 141

[Report No. 115-21]

To improve understanding and forecasting of space weather events, and for other purposes.

IN THE SENATE OF THE UNITED STATES

JANUARY 12, 2017

Mr. PETERS (for himself, Mr. GARDNER, Mr. BOOKER, Mr. WICKER, Ms. KLOBUCHAR, and Mr. NELSON) introduced the following bill; which was read twice and referred to the Committee on Commerce, Science, and Transportation

MARCH 30, 2017

Reported by Mr. THUNE, with an amendment

[Strike out all after the enacting clause and insert the part printed in italic]

A BILL

To improve understanding and forecasting of space weather events, and for other purposes.

1 *Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,*

3 **SECTION 1. SHORT TITLE.**

4 This Act may be cited as the “Space Weather Research and Forecasting Act”.

1 SEC. 2. SPACE WEATHER.

2 (a) IN GENERAL.—Subtitle VI of title 51, United
3 States Code, is amended by adding after chapter 605 the
4 following:

5 **“CHAPTER 607—SPACE WEATHER**

“60701. Space weather.

“60702. Observations and forecasting.

“60703. Research and technology.

“60704. Space weather data.

6 **“§ 60701. Space weather**

7 “(a) FINDINGS.—Congress makes the following find-
8 ings:

9 “(1) Space weather events pose a significant
10 threat to humans working in the space environment
11 and to modern technological systems.

12 “(2) The effects of severe space weather events
13 on the electric power grid, satellites and satellite
14 communications and information, airline operations,
15 astronauts living and working in space, and space-
16 based position, navigation, and timing systems could
17 have significant societal, economic, national security,
18 and health impacts.

19 “(3) Earth and space observations provide cru-
20 cial data necessary to predict and warn about space
21 weather events.

22 “(4) Clear roles and accountability of Federal
23 departments and agencies are critical for an efficient

1 and effective response to threats posed by space
2 weather.

3 “(5) In October 2015, the National Science and
4 Technology Council published a National Space
5 Weather Strategy and a National Space Weather
6 Action Plan seeking to integrate national space
7 weather efforts and add new capabilities to meet in-
8 creasing demand for space weather information.

9 “(b) FEDERAL AGENCY ROLES.—

10 “(1) FINDINGS.—Congress finds that—

11 “(A) the National Oceanic and Atmos-
12 pheric Administration provides operational
13 space weather forecasting and monitoring for
14 civil applications; maintains ground and space-
15 based assets to provide observations needed for
16 forecasting, prediction, and warnings, and de-
17 velops requirements for space weather fore-
18 casting technologies and science;

19 “(B) the Department of Defense provides
20 operational space weather forecasting, moni-
21 toring, and research for the department’s
22 unique missions and applications;

23 “(C) the National Aeronautics and Space
24 Administration provides increased under-
25 standing of the fundamental physics of the

1 Sun-Earth system through space-based observa-
2 tions and modeling; develops new space-based
3 technologies and missions; and monitors space
4 weather for NASA's space missions;

5 “(D) the National Science Foundation pro-
6 vides increased understanding of the Sun-Earth
7 system through ground-based measurements,
8 technologies, and modeling;

9 “(E) the Department of the Interior col-
10 lects, distributes, and archives operational
11 ground-based magnetometer data in the United
12 States and its territories, and works with the
13 international community to improve global geo-
14 physical monitoring and develops crustal con-
15 ductivity models to assess and mitigate risk
16 from space weather induced electric ground cur-
17 rents; and

18 “(F) the Federal Aviation Administration
19 provides operational requirements for space
20 weather services in support of aviation and for
21 coordination of these requirements with the
22 International Civil Aviation Organization; inte-
23 grates space weather data and products into the
24 Next Generation Air Transportation System;
25 and conducts real-time monitoring of the

1 charged particle radiation environment to pro-
2 tect the health and safety of crew and pas-
3 sengers during space weather events.

4 **“(2) OFFICE OF SCIENCE AND TECHNOLOGY**
5 **POLICY.**—The Director of the Office of Science and
6 Technology Policy shall—

7 “(A) coordinate the development and im-
8 plementation of Federal Government activities
9 to improve the Nation’s ability to prepare,
10 avoid, mitigate, respond to, and recover from
11 potentially devastating impacts of space weath-
12 er events; and

13 “(B) coordinate the activities of the Na-
14 tional Space Weather Program members.

15 **“(c) SPACE WEATHER INTERAGENCY WORKING**
16 **GROUP.**—In order to continue coordination of executive
17 branch efforts to understand, prepare, coordinate, and
18 plan for space weather, the National Science and Tech-
19 nology Council shall establish an interagency working
20 group on space weather that includes representatives of
21 the Federal agencies participating in the National Space
22 Weather Program, and of other Federal agencies, as ap-
23 propriate.

24 **“(d) NATIONAL SPACE WEATHER PROGRAM.**—In
25 order to understand and respond to the adverse effects

1 of space weather, the National Space Weather Program
2 shall leverage capabilities across participating Federal
3 agencies, including—

4 “(1) the National Oceanic and Atmospheric Ad-
5 ministration;

6 “(2) the National Aeronautics and Space Ad-
7 ministration;

8 “(3) the National Science Foundation;

9 “(4) the Department of Defense;

10 “(5) the Department of the Interior;

11 “(6) the Department of Homeland Security;

12 “(7) the Department of Energy;

13 “(8) the Department of Transportation, includ-
14 ing the Federal Aviation Administration; and

15 “(9) the Department of State.

16 “(e) INTERAGENCY AGREEMENTS.—

17 “(1) SENSE OF CONGRESS.—It is the sense of
18 Congress that the interagency collaboration between
19 the National Aeronautics and Space Administration
20 and the National Oceanic and Atmospheric Adminis-
21 tration on terrestrial weather observations pro-
22 vides—

23 “(A) an effective mechanism for improving
24 weather and climate data collection while avoid-

1 ing unnecessary duplication of capabilities
2 across Federal agencies; and

3 “(B) an agency collaboration model that
4 could benefit space weather observations.

5 **“(2) INTERAGENCY AGREEMENTS.**—The Ad-
6 ministrator of the National Aeronautics and Space
7 Administration and the Administrator of the Na-
8 tional Oceanic and Atmospheric Administration shall
9 enter into one or more interagency agreements pro-
10 viding for cooperation and collaboration in the devel-
11 opment of space weather spacecraft, instruments,
12 and technologies in accordance with this chapter.

13 **“§ 60702. Observations and forecasting**

14 **“(a) POLICY.**—It is the policy of the United States
15 to establish and sustain a baseline capability for space
16 weather observations.

17 **“(b) INTEGRATED STRATEGY.**—

18 **“(1) IN GENERAL.**—The Director of the Office
19 of Science and Technology Policy, in coordination
20 with the Administrator of the National Oceanic and
21 Atmospheric Administration, the Administrator of
22 the National Aeronautics and Space Administration,
23 the Director of the National Science Foundation,
24 and the Secretary of Defense, and in consultation
25 with the academic and commercial communities,

1 shall develop an integrated strategy for solar and
2 solar wind observations beyond the lifetime of cur-
3 rent assets; that considers—

4 “(A) the provision of solar wind measure-
5 ments and other measurements essential to
6 space weather forecasting; and

7 “(B) the provision of solar and space
8 weather measurements important for scientific
9 purposes.

10 “(2) CONSIDERATIONS.—In developing the
11 strategy under paragraph (1), the Director of the
12 Office of Science and Technology Policy shall con-
13 sider small satellite options, hosted payloads, com-
14 mercial options, international options, and prize au-
15 thority.

16 “(c) CRITICAL OBSERVATIONS.—In order to sustain
17 current space-based observational capabilities, the Admin-
18 istrator of the National Aeronautics and Space Adminis-
19 tration shall—

20 “(1) in cooperation with the European Space
21 Agency, maintain operations of the Solar and
22 Heliospheric Observatory/Large Angle and Spe-
23 temetric Coronagraph (referred to in this section as
24 ‘SOHO/LASCO’) for as long as the satellite con-
25 tinues to deliver quality observations; and

1 “(2) prioritize the reception of LASCO data.

2 “(d) ADDITIONAL CAPABILITY FOR SOLAR IMAG-
3 E~~N~~O.—

4 “(1) IN GENERAL.—The Administrator of the
5 National Oceanic and Atmospheric Administration
6 shall secure reliable secondary capability for near
7 real-time coronal mass ejection imagery.

8 “(2) OPTIONS.—The Administrator of the Na-
9 tional Oceanic and Atmospheric Administration, in
10 coordination with the Secretary of Defense and the
11 Administrator of the National Aeronautics and
12 Space Administration, shall develop options to build
13 and deploy one or more instruments for near real-
14 time coronal mass ejection imagery.

15 “(3) CONSIDERATIONS.—In developing options
16 under paragraph (2), the Administrator of the Na-
17 tional Oceanic and Atmospheric Administration shall
18 consider commercial solutions, prize authority, aca-
19 demic and international partnerships, microsatellites,
20 ground-based instruments, and opportunities to de-
21 ploy the instrument or instruments as a secondary
22 payload on an upcoming planned launch.

23 “(4) COSTS.—In implementing paragraph (1),
24 the Administrator of the National Oceanic and At-

1 mospheric Administration shall prioritize a cost-effec-
2 tive solution.

3 “(5) OPERATIONAL PLANNING.—The Adminis-
4 trator of the National Oceanic and Atmospheric Ad-
5 ministration shall develop an operational contingency
6 plan to provide continuous space weather forecasting
7 in the event of a SOHO/LASCO failure.

8 “(6) BRIEFING.—Not later than 120 days after
9 the date of enactment of the Space Weather Re-
10 search and Forecasting Act, the Administrator of
11 the National Oceanic and Atmospheric Administra-
12 tion shall provide a briefing to the Committee on
13 Commerce, Science, and Transportation of the Sen-
14 ate and the Committee on Science, Space, and Tech-
15 nology of the House of Representatives on the op-
16 tions for building and deploying the instrument or
17 instruments described in paragraph (2) and the
18 operational contingency plan developed under para-
19 graph (5).

20 “(e) FOLLOW-ON SPACE-BASED OBSERVATIONS.—
21 The Administrator of the National Oceanic and Atmos-
22 pheric Administration, in coordination with the Secretary
23 of Defense, shall develop requirements and a plan for fol-
24 low-on space-based observations for operational purposes,

1 in accordance with the integrated strategy developed
2 under subsection (b).

3 “(f) REPORT.—Not later than 180 days after the
4 date of enactment of the Space Weather Research and
5 Forecasting Act, the Director of the Office of Science and
6 Technology Policy shall submit to the Committee on Com-
7 mmerce, Science, and Transportation of the Senate and the
8 Committee on Science, Space, and Technology of the
9 House of Representatives a report on the integrated strat-
10 egy under subsection (b), including the plans for follow-
11 on space-based observations under subsection (e).

12 “(g) GROUND-BASED OBSERVATIONS.—The Na-
13 tional Science Foundation, the Air Force, and where prac-
14 ticable in support of the Air Force, the Navy shall each—

15 “(1) maintain and improve, as necessary and
16 advisable, ground-based observations of the Sun in
17 order to help meet the priorities identified in section
18 60703(a); and

19 “(2) provide space weather data by means of its
20 set of ground-based facilities, including radars,
21 lidars, magnetometers, radio receivers, aurora and
22 airglow imagers, spectrometers, interferometers, and
23 solar observatories.

24 “(h) GROUND-BASED OBSERVATIONS DATA.—The
25 National Science Foundation shall—

1 “(1) provide key data streams from the platforms described in subsection (g) for research and to support space weather model development;

4 “(2) develop experimental models for scientific purposes; and

6 “(3) support the transition of the experimental models to operations where appropriate.

8 **“§ 60703. Research and technology**

9 “(a) USER NEEDS.—

10 “(1) IN GENERAL.—The Administrator of the National Oceanic and Atmospheric Administration, the Secretary of the Air Force, and where practicable in support of the Air Force, the Secretary of the Navy, in conjunction with the heads of other relevant Federal agencies, shall conduct a comprehensive survey to identify and prioritize the needs of space weather forecast users, including space weather data and space weather forecast data needed to improve services and inform research priorities and technology needs.

21 “(2) CONTENTS.—In conducting the comprehensive survey under paragraph (1), the Administrator of the National Oceanic and Atmospheric Administration, the Secretary of the Air Force, and

1 where practicable in support of the Air Force, the
2 Secretary of the Navy, at a minimum, shall—

3 “(A) consider the goals for forecast lead
4 time, accuracy, coverage, timeliness, data rate,
5 and data quality for space weather observa-
6 tions;

7 “(B) identify opportunities to address the
8 needs identified under paragraph (1) through
9 collaborations with academia, the private sector,
10 and the international community;

11 “(C) identify opportunities for new tech-
12 nologies and instrumentation to address the
13 needs identified under paragraph (1); and

14 “(D) publish a report on the findings
15 under subparagraphs (A) through (C).

16 “(3) PUBLICATION.—Not later than 1 year
17 after the date of enactment of the Space Weather
18 Research and Forecasting Act, the Administrator of
19 the National Oceanic and Atmospheric Administra-
20 tion, the Secretary of the Air Force, and where praet-
21 tieable in support of the Air Force, the Secretary of
22 the Navy, shall—

23 “(A) make the results of the comprehen-
24 sive survey publicly available; and

1 “(B) notify the Committee on Commerce,
2 Science, and Transportation of the Senate and
3 the Committee on Science, Space, and Tech-
4 nology of the House of Representatives of the
5 publication under subparagraph (A).

6 **“(b) RESEARCH ACTIVITIES.—**

7 “(1) BASIC RESEARCH.—As part of the Na-
8 tional Space Weather Program, the Director of the
9 National Science Foundation, Administrator of the
10 National Aeronautics and Space Administration, and
11 Secretary of Defense shall continue to carry out
12 basic research activities on heliophysics, geospace
13 science, and space weather and support competitive,
14 merit-based, peer-reviewed proposals for research,
15 modeling, and monitoring of space weather and its
16 impacts, including science goals outlined in Solar
17 and Space Physics Decadal surveys conducted by the
18 National Academy of Sciences.

19 **“(2) MULTIDISCIPLINARY RESEARCH.—**

20 “(A) FINDINGS.—Congress finds that the
21 multidisciplinary nature of solar and space
22 physics creates funding challenges that require
23 coordination across scientific disciplines and
24 Federal agencies.

1 “(B) MULTIDISCIPLINARY RESEARCH.—As
2 part of the National Space Weather Program,
3 the Director of the National Science Foundation,
4 the Administrator of the National Oceanic
5 and Atmospheric Administration, and the Ad-
6 ministrator of the National Aeronautics and
7 Space Administration shall pursue multidisci-
8 plinary research in subjects that further our
9 understanding of solar physics, space physics,
10 and space weather.

11 “(C) SENSE OF CONGRESS.—It is the
12 sense of Congress that the Administrator of the
13 National Aeronautics and Space Administration
14 and Director of the National Science Founda-
15 tion should support competitively awarded
16 Heliophysics Science Centers.

17 “(e) SCIENCE MISSIONS.—The Administrator of the
18 National Aeronautics and Space Administration shall seek
19 to implement missions that meet the science objectives
20 identified in Solar and Space Physics Decadal surveys con-
21 ducted by the National Academy of Sciences.

22 “(d) RESEARCH TO OPERATIONS.—

23 “(1) IN GENERAL.—The Administrator of the
24 National Aeronautics and Space Administration, the
25 Director of the National Science Foundation, the

1 Administrator of the National Oceanic and Atmos-
2 pheric Administration, the Secretary of the Air
3 Force, and where practicable in support of the Air
4 Force, the Secretary of the Navy, shall—

5 “(A) develop a formal mechanism to tran-
6 sition National Aeronautics and Space Adminis-
7 tration, National Science Foundation, Air
8 Force, and Navy research findings, models, and
9 capabilities, as appropriate, to National Oceanic
10 and Atmospheric Administration and Depart-
11 ment of Defense space weather operational fore-
12 casting centers; and

13 “(B) enhance coordination between re-
14 search modeling centers and forecasting cen-
15 ters.

16 “(2) OPERATIONAL NEEDS.—The Adminis-
17 trator of the National Oceanic and Atmospheric Ad-
18 ministration and the Secretary of Defense, in coordi-
19 nation with the Administrator of the National Aero-
20 nautics and Space Administration and the Director
21 of the National Science Foundation, shall develop a
22 formal mechanism to communicate the operational
23 needs of space weather forecasters to the research
24 community.

25 “(e) TECHNOLOGY DEVELOPMENT.—

1 “(1) FINDINGS.—Congress finds that observa-
2 tions and measurements closer to the Sun and ad-
3 vanced instrumentation would provide for more ad-
4 vanced warning of space weather disturbances (as
5 defined in section 3 of the Space Weather Research
6 and Forecasting Act).

7 “(2) TECHNOLOGY AND INSTRUMENTATION DE-
8 VELOPMENT.—The Administrator of the National
9 Aeronautics and Space Administration and the Di-
10 rector of the National Science Foundation shall sup-
11 port the development of technologies and instrumen-
12 tation to improve space weather forecasting lead-
13 time and accuracy to meet the needs identified by
14 the Administrator of the National Oceanic and At-
15 mospheric Administration.

16 **“§ 60704. Space weather data**

17 “(a) IN GENERAL.—The Administrator of the Na-
18 tional Aeronautics and Space Administration and the Di-
19 rector of the National Science Foundation shall—

20 “(1) make space weather related data obtained
21 for scientific research purposes available to space
22 weather forecasters and operations centers; and

23 “(2) support model development and model ap-
24 plications to space weather forecasting.

1 “(b) RESEARCH.—The Administrator of the National
2 Oceanic and Atmospheric Administration shall make space
3 weather related data obtained from operational forecasting
4 available for scientific research.”.

5 **(b) TECHNICAL AND CONFORMING AMENDMENTS.—**

6 **(1) REPEAL OF SECTION 809.**—Section 809 of
7 the National Aeronautics and Space Administration
8 Authorization Act of 2010 (42 U.S.C. 18388) and
9 the item relating to that section in the table of con-
10 tents under section 4(b) of that Act (124 Stat.
11 2806) are repealed.

12 **(2) TABLE OF CHAPTERS.**—The table of chap-
13 ters of title 51, United States Code, is amended by
14 adding after the item relating to chapter 605 the fol-
15 lowing:

“607. Space weather 60701”.

16 **SEC. 3. SPACE WEATHER METRICS.**

17 **(a) DEFINITIONS.**—In this section:

18 **(1) SPACE WEATHER DISTURBANCE.**—The term
19 “space weather disturbance” includes geo-electric
20 fields, ionizing radiation, ionospheric disturbances,
21 solar radio bursts, and upper atmospheric expansion.

22 **(2) SPACE WEATHER BENCHMARK.**—The term
23 “space weather benchmark” means the physical
24 characteristics and conditions describing the nature,

1 frequency, and intensity of space weather disturbances.
2

3 (b) **BENCHMARKS.**—

4 (1) **PRELIMINARY.**—Not later than 90 days
5 after the date of enactment of this Act, the Space
6 Weather Interagency Working Group, established
7 under section 60701 of title 51, United States Code,
8 in consultation with academic and commercial ex-
9 perts, shall—

10 (A) assess existing data, the historical
11 record, models, and peer-reviewed studies on
12 space weather; and

13 (B) develop preliminary benchmarks, based
14 on current scientific understanding and the his-
15 torical record, for measuring solar disturbances.

16 (2) **FINAL.**—Not later than 18 months after
17 the date the preliminary benchmarks are developed
18 under paragraph (1), the Space Weather Inter-
19 agency Working Group shall publish final bench-
20 marks.

21 (3) **REVIEW.**—The Administrator of the Na-
22 tional Aeronautics and Space Administration shall
23 contract with the National Academy of Sciences to
24 review the benchmarks established under paragraph
25 (2).

1 (4) REVISIONS.—The Space Weather Inter-
2 agency Working Group shall update and revise the
3 final benchmarks under paragraph (2), as necessary,
4 based on—

5 (A) the results of the review under para-
6 graph (3);

7 (B) any significant new data or advances
8 in scientific understanding that become avail-
9 able; or

10 (C) the evolving needs of entities impacted
11 by solar disturbances.

12 **SEC. 4. PROTECTION OF CRITICAL INFRASTRUCTURE.**

13 (a) IN GENERAL.—The Administrator of the Na-
14 tional Oceanic and Atmospheric Administration, in con-
15 sultation with the heads of other relevant Federal agen-
16 cies, shall provide information about space weather haz-
17 ards to the Secretary of Homeland Security for purposes
18 of this section.

19 (b) CRITICAL INFRASTRUCTURE.—The Secretary of
20 Homeland Security, in consultation with sector-specific
21 agencies, the Administrator of the National Oceanic and
22 Atmospheric Administration, and the heads of other rel-
23 evant agencies, shall—

24 (I) include, in meeting national critical infra-
25 structure reporting requirements, an assessment of

1 the vulnerability of critical infrastructure to space
2 weather events, as described by the space weather
3 benchmarks under section 3; and

4 (2) support critical infrastructure providers in
5 managing the risks and impacts associated with
6 space weather.

7 (e) PROHIBITION ON NEW REGULATORY AUTHORITY.—Nothing in subsection (b) may be construed to grant
8 the Secretary of Homeland Security any authority to pro-
9 mulgate regulations that was not in effect on the day be-
10 fore the date of enactment of this Act.

12 (d) DEFINITION OF SECTOR-SPECIFIC AGENCY.—In
13 this section, the term “sector-specific agency” has the
14 meaning given the term in Presidential Policy Directive-
15 21 of February 12, 2013 (Critical Infrastructure Security
16 and Resilience), or any successor.

17 **SEC. 5. PROTECTION OF NATIONAL SECURITY ASSETS.**

18 (a) IN GENERAL.—The National Security Council, in
19 consultation with the Office of the Director of National
20 Intelligence, the Secretary of Defense, and the heads of
21 other relevant Federal agencies, shall—

22 (1) assess the vulnerability of the national secu-
23 rity community to space weather events, as described
24 by the space weather benchmarks under section 3;
25 and

1 (2) develop national security mechanisms to
2 protection national security assets from space weather
3 threats.

4 (b) COOPERATION.—The Secretary of Defense, in
5 consultation with the heads of other relevant Federal
6 agencies, shall provide information about space weather
7 hazards to the National Security Council, Director of Na-
8 tional Intelligence, and heads of Defense Agencies for pur-
9 poses of this section.

10 **SEC. 6. ENSURING THE SAFETY OF CIVIL AVIATION.**

11 (a) IN GENERAL.—The Administrator of the Federal
12 Aviation Administration, in consultation with the heads of
13 other relevant Federal agencies, shall—

14 (1) assess the safety implications and vulner-
15 ability of the national airspace system by space
16 weather events, as described by the space weather
17 benchmarks under section 3;

18 (2) assess methods to mitigate the safety impli-
19 cations and effects of space weather on aviation
20 communication systems, aircraft navigation systems,
21 satellite and ground-based navigation systems, and
22 potential health effects of radiation exposure; and

23 (3) assess options for incorporating space
24 weather into operational training for pilots, cabin

1 crew, dispatchers, air traffic controllers, meteorolo-
2 gists, and engineers.

3 (b) SPACE WEATHER COMMUNICATION.—The Ad-
4 ministrator of the Federal Aviation Administration, in
5 consultation with the heads of other relevant Federal
6 agencies, shall develop methods to increase the interaction
7 between the aviation community and the space weather re-
8 search and service provider community.

9 **SECTION 1. SHORT TITLE.**

10 This Act may be cited as the “Space Weather Research
11 and Forecasting Act”.

12 **SEC. 2. SPACE WEATHER.**

13 (a) IN GENERAL.—Subtitle VI of title 51, United
14 States Code, is amended by adding after chapter 605 the
15 following:

16 **“CHAPTER 607—SPACE WEATHER**

“60701. Space weather.

“60702. Observations and forecasting.

“60703. Research and technology.

“60704. Space weather data.

17 **“§ 60701. Space weather**

18 “(a) FINDINGS.—Congress makes the following find-
19 ings:

20 “(1) Space weather events pose a significant
21 threat to humans working in the space environment
22 and to modern technological systems.

1 “(2) *The effects of severe space weather events on*
2 *the electric power grid, satellites and satellite commu-*
3 *nications and information, airline operations, astro-*
4 *nauts living and working in space, and space-based*
5 *position, navigation, and timing systems could have*
6 *significant societal, economic, national security, and*
7 *health impacts.*

8 “(3) *Earth and space observations provide cru-*
9 *cial data necessary to predict and warn about space*
10 *weather events.*

11 “(4) *Clear roles and accountability of Federal*
12 *departments and agencies are critical for an efficient*
13 *and effective response to threats posed by space weath-*
14 *er.*

15 “(5) *In October 2015, the National Science and*
16 *Technology Council published a National Space*
17 *Weather Strategy and a National Space Weather Ac-*
18 *tion Plan seeking to integrate national space weather*
19 *efforts and add new capabilities to meet increasing*
20 *demand for space weather information.*

21 “(b) *FEDERAL AGENCY ROLES.—*

22 “(1) *FINDINGS.—Congress finds that—*

23 “(A) *the National Oceanic and Atmospheric*
24 *Administration provides operational space*
25 *weather forecasting and monitoring for civil ap-*

1 *plications, maintains ground and space-based*
2 *assets to provide observations needed for fore-*
3 *casting, prediction, and warnings, and develops*
4 *requirements for space weather forecasting tech-*
5 *nologies and science;*

6 “*(B) the Department of Defense provides*
7 *operational space weather forecasting, moni-*
8 *toring, and research for the department’s unique*
9 *missions and applications;*

10 “*(C) the National Aeronautics and Space*
11 *Administration provides increased under-*
12 *standing of the fundamental physics of the Sun-*
13 *Earth system through space-based observations*
14 *and modeling, develops new space-based tech-*
15 *nologies and missions, and monitors space*
16 *weather for NASA’s space missions;*

17 “*(D) the National Science Foundation pro-*
18 *vides increased understanding of the Sun-Earth*
19 *system through ground-based measurements,*
20 *technologies, and modeling;*

21 “*(E) the Department of the Interior collects,*
22 *distributes, and archives operational ground-*
23 *based magnetometer data in the United States*
24 *and its territories, and works with the inter-*
25 *national community to improve global geo-*

1 *physical monitoring and develops crustal con-*
2 *ductivity models to assess and mitigate risk from*
3 *space weather induced electric ground currents;*
4 *and*

5 “(F) the Federal Aviation Administration
6 provides operational requirements for space
7 weather services in support of aviation and for
8 coordination of these requirements with the
9 International Civil Aviation Organization, inte-
10 grates space weather data and products into the
11 Next Generation Air Transportation System,
12 and conducts real-time monitoring of the charged
13 particle radiation environment to protect the
14 health and safety of crew and passengers during
15 space weather events.

16 “(2) OFFICE OF SCIENCE AND TECHNOLOGY POL-
17 ICY.—The Director of the Office of Science and Tech-
18 nology Policy shall—

19 “(A) coordinate the development and imple-
20 mentation of Federal Government activities to
21 improve the Nation’s ability to prepare, avoid,
22 mitigate, respond to, and recover from poten-
23 tially devastating impacts of space weather
24 events; and

1 “(B) coordinate the activities of the space
2 weather interagency working group established
3 under subsection (c).

4 “(c) *SPACE WEATHER INTERAGENCY WORKING*
5 *GROUP.*—In order to continue coordination of executive
6 branch efforts to understand, prepare, coordinate, and plan
7 for space weather, the National Science and Technology
8 Council shall establish an interagency working group on
9 space weather.

10 “(d) *MEMBERSHIP.*—In order to understand and re-
11 spond to the adverse effects of space weather, the interagency
12 working group established under subsection (c) shall lever-
13 age capabilities across participating Federal agencies, in-
14 cluding—

15 “(1) the National Oceanic and Atmospheric Ad-
16 ministration;

17 “(2) the National Aeronautics and Space Ad-
18 ministration;

19 “(3) the National Science Foundation;

20 “(4) the Department of Defense;

21 “(5) the Department of the Interior;

22 “(6) the Department of Homeland Security;

23 “(7) the Department of Energy;

24 “(8) the Department of Transportation, includ-
25 ing the Federal Aviation Administration; and

1 “(9) the Department of State.

2 “(e) INTERAGENCY AGREEMENTS.—

3 “(1) SENSE OF CONGRESS.—It is the sense of
4 Congress that the interagency collaboration between
5 the National Aeronautics and Space Administration
6 and the National Oceanic and Atmospheric Adminis-
7 tration on terrestrial weather observations provides—

8 “(A) an effective mechanism for improving
9 weather and climate data collection while avoid-
10 ing unnecessary duplication of capabilities
11 across Federal agencies; and

12 “(B) an agency collaboration model that
13 could benefit space weather observations.

14 “(2) INTERAGENCY AGREEMENTS.—The Admin-
15 istrator of the National Aeronautics and Space Ad-
16 ministration and the Administrator of the National
17 Oceanic and Atmospheric Administration shall enter
18 into one or more interagency agreements providing
19 for cooperation and collaboration in the development
20 of space weather spacecraft, instruments, and tech-
21 nologies in accordance with this chapter.

22 **“§ 60702. Observations and forecasting**

23 “(a) POLICY.—It is the policy of the United States to
24 establish and sustain a baseline capability for space weath-
25 er observations.

1 “(b) INTEGRATED STRATEGY.—

2 “(1) IN GENERAL.—The Director of the Office of
3 Science and Technology Policy, in coordination with
4 the Administrator of the National Oceanic and At-
5 mospheric Administration, the Administrator of the
6 National Aeronautics and Space Administration, the
7 Director of the National Science Foundation, and the
8 Secretary of Defense, and in consultation with the
9 academic and commercial communities, shall develop
10 an integrated strategy for solar and solar wind obser-
11 vations beyond the lifetime of current assets, that con-
12 siders—

13 “(A) the provision of solar wind measure-
14 ments and other measurements essential to space
15 weather forecasting; and

16 “(B) the provision of solar and space weath-
17 er measurements important for scientific pur-
18 poses.

19 “(2) CONSIDERATIONS.—In developing the strat-
20 egy under paragraph (1), the Director of the Office of
21 Science and Technology Policy shall consider small
22 satellite options, hosted payloads, commercial options,
23 international options, and prize authority.

24 “(c) CRITICAL OBSERVATIONS.—In order to sustain
25 current space-based observational capabilities, the Adminis-

1 *trator of the National Aeronautics and Space Administra-*
2 *tion shall—*

3 “(1) *in cooperation with the European Space*
4 *Agency, maintain operations of the Solar and*
5 *Heliospheric Observatory/Large Angle and Spec-*
6 *trometric Coronagraph (referred to in this section as*
7 *‘SOHO/LASCO’) for as long as the satellite continues*
8 *to deliver quality observations; and*

9 “(2) *prioritize the reception of LASCO data.*

10 “(d) *ADDITIONAL CAPABILITY FOR SOLAR IMAGING.—*

11 “(1) *IN GENERAL.—The Administrator of the*
12 *National Oceanic and Atmospheric Administration*
13 *shall secure reliable secondary capability for near*
14 *real-time coronal mass ejection imagery.*

15 “(2) *OPTIONS.—The Administrator of the Na-*
16 *tional Oceanic and Atmospheric Administration, in*
17 *coordination with the Secretary of Defense and the*
18 *Administrator of the National Aeronautics and Space*
19 *Administration, shall develop options to build and de-*
20 *ploy one or more instruments for near real-time cor-*
21 *onal mass ejection imagery.*

22 “(3) *CONSIDERATIONS.—In developing options*
23 *under paragraph (2), the Administrator of the Na-*
24 *tional Oceanic and Atmospheric Administration shall*
25 *consider commercial solutions, prize authority, aca-*

1 *demic and international partnerships, microsatellites,*
2 *ground-based instruments, and opportunities to de-*
3 *ploy the instrument or instruments as a secondary*
4 *payload on an upcoming planned launch.*

5 “(4) COSTS.—In implementing paragraph (1),
6 *the Administrator of the National Oceanic and At-*
7 *mospheric Administration shall prioritize a cost-effic-*
8 *tive solution.*

9 “(5) OPERATIONAL PLANNING.—The Adminis-
10 *trator of the National Oceanic and Atmospheric Ad-*
11 *ministration shall develop an operational contingency*
12 *plan to provide continuous space weather forecasting*
13 *in the event of a SOHO/LASCO failure.*

14 “(6) BRIEFING.—Not later than 120 days after
15 *the date of enactment of the Space Weather Research*
16 *and Forecasting Act, the Administrator of the Na-*
17 *tional Oceanic and Atmospheric Administration shall*
18 *provide a briefing to the Committee on Commerce,*
19 *Science, and Transportation of the Senate and the*
20 *Committee on Science, Space, and Technology of the*
21 *House of Representatives on the options for building*
22 *and deploying the instrument or instruments de-*
23 *scribed in paragraph (2) and the operational contin-*
24 *gency plan developed under paragraph (5).*

1 “(e) FOLLOW-ON SPACE-BASED OBSERVATIONS.—The
2 *Administrator of the National Oceanic and Atmospheric*
3 *Administration, in coordination with the Secretary of De-*
4 *fense, shall develop requirements and a plan for follow-on*
5 *space-based observations for operational purposes, in ac-*
6 *cordance with the integrated strategy developed under sub-*
7 *section (b).*

8 “(f) REPORT.—Not later than 180 days after the date
9 *of enactment of the Space Weather Research and Fore-*
10 *casting Act, the Director of the Office of Science and Tech-*
11 *nology Policy shall submit to the Committee on Commerce,*
12 *Science, and Transportation of the Senate and the Com-*
13 *mittee on Science, Space, and Technology of the House of*
14 *Representatives a report on the integrated strategy under*
15 *subsection (b), including the plans for follow-on space-based*
16 *observations under subsection (e).*

17 “(g) GROUND-BASED OBSERVATIONS.—The National
18 *Science Foundation, the Air Force, and where practicable*
19 *in support of the Air Force, the Navy shall each—*

20 “(1) *maintain and improve, as necessary and*
21 *advisable, ground-based observations of the Sun in*
22 *order to help meet the priorities identified in section*
23 *60703(a); and*

24 “(2) *provide space weather data by means of its*
25 *set of ground-based facilities, including radars, lidars,*

1 *magnetometers, radio receivers, aurora and airglow*
2 *imagers, spectrometers, interferometers, and solar ob-*
3 *servatories.*

4 “(h) GROUND-BASED OBSERVATIONS DATA.—*The Na-*
5 *tional Science Foundation shall—*

6 “(1) provide key data streams from the platforms
7 described in subsection (g) for research and to support
8 space weather model development;

9 “(2) develop experimental models for scientific
10 purposes; and

11 “(3) support the transition of the experimental
12 models to operations where appropriate.

13 **“§ 60703. Research and technology**

14 “(a) USER NEEDS.—

15 “(1) IN GENERAL.—*The Administrator of the*
16 *National Oceanic and Atmospheric Administration,*
17 *the Secretary of the Air Force, and where practicable*
18 *in support of the Air Force, the Secretary of the*
19 *Navy, in conjunction with the heads of other relevant*
20 *Federal agencies, shall conduct a comprehensive sur-*
21 *vey to identify and prioritize the needs of space*
22 *weather forecast users, including space weather data*
23 *and space weather forecast data needed to improve*
24 *services and inform research priorities and technology*
25 *needs.*

1 “(2) CONTENTS.—In conducting the comprehensive survey under paragraph (1), the Administrator
2 of the National Oceanic and Atmospheric Administration, the Secretary of the Air Force, and where practicable in support of the Air Force, the Secretary of the Navy, at a minimum, shall—

7 “(A) consider the goals for forecast lead time, accuracy, coverage, timeliness, data rate, and data quality for space weather observations;

10 “(B) identify opportunities to address the needs identified under paragraph (1) through collaborations with academia, the private sector, and the international community;

14 “(C) identify opportunities for new technologies and instrumentation to address the needs identified under paragraph (1); and

17 “(D) publish a report on the findings under subparagraphs (A) through (C).

19 “(3) PUBLICATION.—Not later than 1 year after the date of enactment of the Space Weather Research and Forecasting Act, the Administrator of the National Oceanic and Atmospheric Administration, the Secretary of the Air Force, and where practicable in support of the Air Force, the Secretary of the Navy, shall—

1 “(A) make the results of the comprehensive
2 survey publicly available; and

3 “(B) notify the Committee on Commerce,
4 Science, and Transportation of the Senate and
5 the Committee on Science, Space, and Tech-
6 nology of the House of Representatives of the
7 publication under subparagraph (A).

8 “(b) RESEARCH ACTIVITIES.—

9 “(1) BASIC RESEARCH.—The Director of the Na-
10 tional Science Foundation, Administrator of the Na-
11 tional Aeronautics and Space Administration, and
12 Secretary of Defense shall continue to carry out basic
13 research activities on heliophysics, geospace science,
14 and space weather and support competitive, merit-
15 based, peer-reviewed proposals for research, modeling,
16 and monitoring of space weather and its impacts, in-
17 cluding science goals outlined in Solar and Space
18 Physics Decadal surveys conducted by the National
19 Academy of Sciences.

20 “(2) MULTIDISCIPLINARY RESEARCH.—

21 “(A) FINDINGS.—Congress finds that the
22 multidisciplinary nature of solar and space
23 physics creates funding challenges that require
24 coordination across scientific disciplines and
25 Federal agencies.

1 “(B) MULTIDISCIPLINARY RESEARCH.—The
2 *Director of the National Science Foundation, the*
3 *Administrator of the National Oceanic and At-*
4 *mospheric Administration, and the Adminis-*
5 *trator of the National Aeronautics and Space*
6 *Administration shall pursue multidisciplinary*
7 *research in subjects that further our under-*
8 *standing of solar physics, space physics, and*
9 *space weather.*

10 “(C) SENSE OF CONGRESS.—*It is the sense*
11 *of Congress that the Administrator of the Na-*
12 *tional Aeronautics and Space Administration*
13 *and Director of the National Science Foundation*
14 *should support competitively awarded*
15 *Heliophysics Science Centers.*

16 “(c) SCIENCE MISSIONS.—*The Administrator of the*
17 *National Aeronautics and Space Administration shall seek*
18 *to implement missions that meet the science objectives iden-*
19 *tified in Solar and Space Physics Decadal surveys con-*
20 *ducted by the National Academy of Sciences.*

21 “(d) RESEARCH TO OPERATIONS.—

22 “(1) IN GENERAL.—*The Administrator of the*
23 *National Aeronautics and Space Administration, the*
24 *Director of the National Science Foundation, the Ad-*
25 *ministrator of the National Oceanic and Atmospheric*

1 *Administration, the Secretary of the Air Force, and*
2 *where practicable in support of the Air Force, the*
3 *Secretary of the Navy, shall—*

4 “(A) develop a formal mechanism to transi-
5 tion National Aeronautics and Space Adminis-
6 tration, National Science Foundation, Air Force,
7 and Navy research findings, models, and capa-
8 bilities, as appropriate, to National Oceanic and
9 Atmospheric Administration and Department of
10 Defense space weather operational forecasting
11 centers; and

12 “(B) enhance coordination between research
13 modeling centers and forecasting centers.

14 “(2) *OPERATIONAL NEEDS.*—The Administrator
15 of the National Oceanic and Atmospheric Administra-
16 tion and the Secretary of Defense, in coordination
17 with the Administrator of the National Aeronautics
18 and Space Administration and the Director of the
19 National Science Foundation, shall develop a formal
20 mechanism to communicate the operational needs of
21 space weather forecasters to the research community.

22 “(e) *TECHNOLOGY DEVELOPMENT.*—

23 “(1) *FINDINGS.*—Congress finds that observa-
24 tions and measurements closer to the Sun and ad-
25 vanced instrumentation would provide for more ad-

1 *vanced warning of space weather disturbances (as de-*
2 *fined in section 3 of the Space Weather Research and*
3 *Forecasting Act).*

4 “(2) TECHNOLOGY AND INSTRUMENTATION DE-
5 *VELOPMENT.—The Administrator of the National Aer-*
6 *onautics and Space Administration and the Director*
7 *of the National Science Foundation shall support the*
8 *development of technologies and instrumentation to*
9 *improve space weather forecasting lead-time and ac-*
10 *curacy to meet the needs identified by the Adminis-*
11 *trator of the National Oceanic and Atmospheric Ad-*
12 *ministration.*

13 **“§ 60704. Space weather data**

14 “(a) IN GENERAL.—*The Administrator of the National*
15 *Aeronautics and Space Administration and the Director of*
16 *the National Science Foundation shall—*

17 “(1) make space weather related data obtained
18 *for scientific research purposes available to space*
19 *weather forecasters and operations centers; and*

20 “(2) support model development and model ap-
21 *plications to space weather forecasting.*

22 “(b) RESEARCH.—*The Administrator of the National*
23 *Oceanic and Atmospheric Administration shall make space*
24 *weather related data obtained from operational forecasting*
25 *available for scientific research.”.*

1 (b) TECHNICAL AND CONFORMING AMENDMENTS.—

2 (1) REPEAL OF SECTION 809.—Section 809 of the
3 National Aeronautics and Space Administration Au-
4 thorization Act of 2010 (42 U.S.C. 18388) and the
5 item relating to that section in the table of contents
6 under section 1(b) of that Act (124 Stat. 2806) are
7 repealed.

8 (2) TABLE OF CHAPTERS.—The table of chapters
9 of title 51, United States Code, is amended by adding
10 after the item relating to chapter 605 the following:

“607. Space weather 60701”.

11 **SEC. 3. SPACE WEATHER METRICS.**

12 (a) DEFINITIONS.—In this section:

13 (1) SPACE WEATHER DISTURBANCE.—The term
14 “space weather disturbance” includes geo-electric
15 fields, ionizing radiation, ionospheric disturbances,
16 solar radio bursts, and upper atmospheric expansion.

17 (2) SPACE WEATHER BENCHMARK.—The term
18 “space weather benchmark” means the physical char-
19 acteristics and conditions describing the nature, fre-
20 quency, and intensity of space weather disturbances.

21 (b) BENCHMARKS.—

22 (1) PRELIMINARY.—Not later than 90 days after
23 the date of enactment of this Act, the Space Weather
24 Interagency Working Group, established under section

1 *60701 of title 51, United States Code, in consultation*
2 *with academic and commercial experts, shall—*

3 (A) *assess existing data, the historical*
4 *record, models, and peer-reviewed studies on*
5 *space weather; and*

6 (B) *develop preliminary benchmarks, based*
7 *on current scientific understanding and the his-*
8 *torical record, for measuring solar disturbances.*

9 (2) *FINAL.—Not later than 18 months after the*
10 *date the preliminary benchmarks are developed under*
11 *paragraph (1), the Space Weather Interagency Work-*
12 *ing Group shall publish final benchmarks.*

13 (3) *REVIEW.—The Administrator of the National*
14 *Aeronautics and Space Administration shall contract*
15 *with the National Academy of Sciences to review the*
16 *benchmarks established under paragraph (2).*

17 (4) *REVISIONS.—The Space Weather Interagency*
18 *Working Group shall update and revise the final*
19 *benchmarks under paragraph (2), as necessary, based*
20 *on—*

21 (A) *the results of the review under para-*
22 *graph (3);*

23 (B) *any significant new data or advances*
24 *in scientific understanding that become avail-*
25 *able; or*

(C) the evolving needs of entities impacted by solar disturbances.

3 SEC. 4. PROTECTION OF CRITICAL INFRASTRUCTURE.

4 (a) IN GENERAL.—The Administrator of the National
5 Oceanic and Atmospheric Administration, in consultation
6 with the heads of other relevant Federal agencies, shall pro-
7 vide information about space weather hazards to the Sec-
8 retary of Homeland Security for purposes of this section.

9 (b) CRITICAL INFRASTRUCTURE.—The Secretary of
10 Homeland Security, in consultation with sector-specific
11 agencies, the Administrator of the National Oceanic and At-
12 mospheric Administration, and the heads of other relevant
13 agencies, shall—

14 (1) include, in meeting national critical infra-
15 structure reporting requirements, an assessment of the
16 vulnerability of critical infrastructure to space weather-
17 er events, as described by the space weather bench-
18 marks under section 3; and

19 (2) support critical infrastructure providers in
20 managing the risks and impacts associated with space
21 weather.

22 (c) PROHIBITION ON NEW REGULATORY AUTHORITY.—Nothing in subsection (b) may be construed to grant
23 the Secretary of Homeland Security any authority to pro-

1 mulgate regulations that was not in effect on the day before
2 the date of enactment of this Act.

3 (d) *DEFINITION OF SECTOR-SPECIFIC AGENCY.*—In
4 this section, the term “sector-specific agency” has the mean-
5 ing given the term in Presidential Policy Directive–21 of
6 February 12, 2013 (Critical Infrastructure Security and
7 Resilience), or any successor.

8 **SEC. 5. PROTECTION OF NATIONAL SECURITY ASSETS.**

9 (a) *IN GENERAL.*—The National Security Council, in
10 consultation with the Office of the Director of National In-
11 telligence, the Secretary of Defense, and the heads of other
12 relevant Federal agencies, shall—

13 (1) assess the vulnerability of the national secu-
14 rity community to space weather events, as described
15 by the space weather benchmarks under section 3; and
16 (2) develop national security mechanisms to pro-
17 tection national security assets from space weather
18 threats.

19 (b) *COOPERATION.*—The Secretary of Defense, in con-
20 sultation with the heads of other relevant Federal agencies,
21 shall provide information about space weather hazards to
22 the National Security Council, Director of National Intel-
23 ligence, and heads of Defense Agencies for purposes of this
24 section.

1 **SEC. 6. ENSURING THE SAFETY OF CIVIL AVIATION.**

2 (a) *IN GENERAL.—The Administrator of the Federal
3 Aviation Administration, in consultation with the heads of
4 other relevant Federal agencies, shall—*

5 (1) *assess the safety implications and vulner-
6 ability of the national airspace system by space
7 weather events, as described by the space weather
8 benchmarks under section 3;*

9 (2) *assess methods to mitigate the safety implica-
10 tions and effects of space weather on aviation commu-
11 nication systems, aircraft navigation systems, satellite
12 and ground-based navigation systems, and potential
13 health effects of radiation exposure; and*

14 (3) *assess options for incorporating space weath-
15 er into operational training for pilots, cabin crew,
16 dispatchers, air traffic controllers, meteorologists, and
17 engineers.*

18 (b) *SPACE WEATHER COMMUNICATION.—The Admin-
19 istrator of the Federal Aviation Administration, in con-
20 sultation with the heads of other relevant Federal agencies,
21 shall develop methods to increase the interaction between
22 the aviation community and the space weather research and
23 service provider community.*

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A BILL

To improve understanding and forecasting of space weather events, and for other purposes.

MARCH 30, 2017

Reported with an amendment